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ABSTRACT

Problem Little data is available to aid physical therapists in writing functional wheelchair velocity goals. **Purpose** This study begins to establish baseline data on wheelchair velocity. The authors hypothesize that there will be a significant relationship between a child's perceived function and their wheelchair velocity over a given distance. **Methods** One female and 10 male community manual wheelchair users aged 11-17 completed 3 time trials of 150 feet on carpet with 1 minute rest between trials. Following the WRAT-R reading screen, the subjects completed a questionnaire about wheelchair function in the community. **Results** A two-tailed significance test of the correlation between wheelchair velocity and overall perceived function proved insignificant, $r(9) = -.0357$, $p = .917$, and shows only one significant coorelation between velocity and individual questions, $r(9) = -.8126$, $p = .002$. **Conclusion** The author's hypothesis cannot be supported statistically, but the study points out the need for future research in the area of wheelchair velocity.

DEDICATION

We would like to dedicate this work to our family and friends. Thank you for your love and support throughout this research.

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TABLE OF CONTENTS

Page

ABSTRACT i

DEDICATION ii

ACKNOWLEDGMENTS iii

LIST OF TABLES vi

CHAPTER

1. INTRODUCTION 1
   - Background to the problem 1
   - Significance of the problem 1
   - Need for the study 1
   - Purpose / hypothesis 2
   - Assumptions 2
2. LITERATURE REVIEW 4
   - Purpose / hypothesis 4
   - Importance in defining patient goal criteria 4
   - Current evaluation tools 5
   - Studies related to functional skills 7
   - Reimbursement issues 9
   - Functional Performance Assessment 9
   - Studies related to ambulation velocity 10
   - Research on environmental variables 11
   - Related federal laws 12
   - Motivation / self-perception studies 13
   - Readability formulas 17

WRAT-R reading screen....18
Summary....20
3. METHODOLOGY....22
Subject inclusion / exclusion criteria....22
Pre-testing procedure....22
Testing procedure....22
Reading screen....23
Human subject review procedure....24
Post-testing procedure....24
4. RESULTS AND ANALYSIS....25
Subject characteristics....25
Statistical analysis....27
Other trends found....28
Hypothesis....30
5. DISCUSSION AND IMPLICATIONS....31
Hypothesis....31
Discussion of statistics....31
Limitations....33
Application of study....34
Suggestions for further study....35
Conclusion....36
REFERENCES....38
APPENDIX A - GVSU HUMAN SUBJECT REVIEW PROPOSAL....42
APPENDIX B - METHODOLOGICAL FORMS....44
APPENDIX C - RAW DATA....52

CHAPTER 1: INTRODUCTION

"At least 645,000 persons in the United States use wheelchairs as their primary mobility method" (Kohn & Enders et al., 1983). This is the typical mobility option for those who are unable to walk. Due to an increasing survival rate of infants with a disability, a large number of children are using wheelchairs in the community. These children must be properly prepared for independent function in the community. This requires using specific evaluation tools and writing appropriate mobility goals.

Current evaluation tools used in rehabilitation, including the Functional Independence Measure (FIM), do not address specific criteria of mobility such as wheelchair propulsion velocity. The FIM defines independence in a wheelchair as the ability to propel 150 feet, turn around, maneuver the chair to a table, bed and toilet, negotiate at least a 3% grade, and maneuver on rugs and over doorsills. Specific velocity requirements are not defined; only the ability to complete the tasks in a "reasonable time". Without defined velocity criteria, it is difficult to write goals for independent community function that are appropriate.

The goal of the physical therapist is to enhance human movement and function and to assess, prevent, and treat movement dysfunction and physical disability (Scully & Barnes, 1989). Empirical evidence of efficacy is needed to demonstrate the unique value of physical therapy. Reimbursement limits set by insurers challenge physical therapists to write specific functional goals to show the uniqueness of the profession.

The purpose of this study is to develop baseline wheelchair propulsion velocity for use with children in the clinic. The authors hypothesize that there will be a significant relationship between a child's perceived function in the community, and their wheelchair velocity over a given distance. If significant relationships are found, the physical therapist may be assisted when writing wheelchair ambulation goals.

This study is needed for rehabilitation professionals, and specifically for physical therapists, to assist in the evaluation and treatment of the mobility needs of a patient. The trend toward integrating the disabled population into the community has resulted in a greater need to properly evaluate their community needs. "Our (physical therapists) desire to provide quality care will be countered by demands for high productivity and efficiency," (Scully & Barnes, 1989). Therefore, physical therapists are challenged to show improvements in their documentation in order to continue receiving reimbursement for treatment.

By properly addressing needs of the patient during the rehabilitation phase, the therapist will prepare the patient for success with mobility skills in the community. When continued successes in the community are experienced, there is an increase in motivation and persistence of wheelchair skills. Perceptions of ability are a driving influence of future motivated behavior (Harter, 1978). The child who feels competent and in control of performance outcomes, will not only be motivated to participate in physical activities, but will exert and sustain effort while striving toward challenging goals (Weiss & Horn, 1990).

The goal of rehabilitation services is to improve life outcomes for persons with physical disabilities. Many variables affect a person's ability to realize these outcomes. Mobility is just one critical variable that must be a priority focus of service delivery (York, 1989).

CHAPTER 2: LITERATURE REVIEW

"The successful integration of the child with disabling conditions into the home and school environment often depends upon the child's ability to perform essential functional activities independently in a safe and timely manner" (Haley, Coster & Ludlow, 1991). Little literature is available regarding what is considered a "timely manner" for tasks such as wheelchair propulsion. A child who is dependent on a wheelchair must not only be able to propel the wheelchair the required distance, but must also be able to keep up with peers in the school and community settings.

The authors' intent is to correlate children's wheelchair velocity with their perceived function in the school and store/mall settings. The hypothesis of this study is that there will be a significant relationship between a child's perceived function and their wheelchair velocity over a given distance. This will give physical therapists in rehabilitation settings a timed reference for wheelchair propulsion.

Independent community ambulation is an important goal in the rehabilitation setting for children who are dependent on a wheelchair. Therefore, in order to establish functional goals, rehabilitation departments must define criteria for patient integration into the community. This is important for many reasons. First, definition of criteria will help therapists to set goals that will appropriately prepare a child for successful community ambulation. These criteria will help refine present evaluation tools. Second, specific criteria will be beneficial for reimbursement of therapy services. Third, there has been a significant growth in the disabled population, and it is essential that their needs are appropriately addressed. Fourth, there has been an increasing trend toward integrating the disabled into the community. Last, when performance outcomes are positive, feelings of competence, efficacy, pleasure and joy are experienced (White, 1959). These feelings motivate the child to continue improving functional skills (Harter, 1978, 1982; Ulrich, 1987).

Although children (with spina bifida) now have the ability to achieve an excellent quality of life, many have not acquired the necessary skills or resources to achieve full independence (Wade, 1994). It is the job of rehabilitation professionals to ensure that children are capable of performing functionallyin the community before discharge. Specific definition of velocity criteria will help to address the physical therapy goals needed for the discharge of patients into the community. Current evaluation tools used to determine functional independence, such as the Functional Independence Measure (FIM), do not address the higher level needs for independence in the community.

The FIM scale is a fairly new functional status instrument used among rehabilitation professionals to determine the degree of disability that patients experience and the amount of progress they make. The FIM has thirteen motor items, one of which is locomotion (walking/wheelchair propulsion). Each motor item is graded on seven levels that appear to have good clinical inter-rater agreement (Heinemann, Linacre, Wright, Hamilton, & Granger, 1993). Patients at FIM levels 1 and 2 are considered to be dependent on others, at levels 3, 4 and 5 they require varying assistance from another person, and at levels 6 and 7 they are functioning independently (Granger, Hamilton, Linacre, Heinemann, & Wright, 1993). Modified independence means that the activity requires any one or more of the following: an assistive device, more than reasonable time, or safety (risk) considerations. No definition of "more than reasonable time" is given for wheelchair propulsion. Because using a wheelchair is considered "modified independence", a wheelchair user is unable to earn a score of 7.

A score of a 6 is obtained by a wheelchair user if the patient can propel 150 feet, turn around, maneuver the chair to a table, bed, and toilet, negotiate at least a 3% grade, and maneuver on rugs and over door sills. A score of 5 may be obtained if the patient can propel 150 feet, but requires standby supervision, cuing, or coaxing or can propel independently short distances (a maximum of 50 feet). A 4 is scored if the patient performs 75% or more of the locomotion effort, a score of 3 is given if the patient performs 50% to 74% of the effort, a 2 if 25% to 49% of the effort is performed and a 1 if less than 25% of the effort is performed. The authors chose 150 feet for this study because it is the longest distance requirement for wheelchair independence when using the FIM. The goal of the writers of the FIM was to construct a set of linear measures that are useful over as large a range of impairments as possible without losing clear distinctions between patients with different impairments (Heinemann et al., 1993).

The FIM was created in 1987 by Granger and Hamilton et al as part of the Uniform Data System for Medical Rehabilitation (UDS) with the support of the American Congress of Rehabilitation Medicine and the American Academy of Physical Medicine and Rehabilitation (Hamilton, Granger, Sherwin, Zielezny, & Tashman, 1987). Construct validity of the FIM is supported by the patterns of item difficulties across impairment groups when the FIM is converted from an ordinal scale into an equal-interval measure using Rash analysis, as was done in the study by Heinemann and Linacre et al. (1993). The FIM has high internal consistency and appears to have broad discriminative capabilities for rehabilitation patients, but does not measure more specific functional skills such as fine motor ability, speed, and ease of task completion or quality of task execution (Dodds, Martin, Deyo, & Stolov, 1993).

The need for specific functional skills was addressed in two studies. These studies revealed that patients discharged from rehabilitation settings, who were considered community ambulators by the treating therapist, were unable to meet velocity and distance criteria needed in the community as determined by the authors. Although these studies only looked at walking velocities, the results reveal the inadequacies of current discharge criteria.

A survey of the physical therapists from 17 rehabilitation hospitals in Los Angeles County revealed that 11 of the 17 departments lacked criteria for defining the desegregation of community ambulators, and none of the departments had velocity requirements for functional community ambulation (Lerner-Frankiel, Vargas, Brown, Krusell, & Schoneberger, 1986). To determine most frequently visited community sites, 30 males and females between 40 and 70 years of age were asked to list the 10 sites that they traveled to most frequently. From this list, the authors selected the supermarket, drug store, bank, a department store within a shopping mall, the post office, and physician's office. Ten sites in each category were chosen, and distances, curb heights, and cross-walk signal time were measured. Distances for the six destinations ranged from 33 meters to almost 600 meters (108 feet to almost 1,945 feet). Crossing signals required a normal walking velocity of 79m/min (259ft/min). The performance of ten persons who had been recently discharged from a rehabilitation hospital after having been designated as independent community ambulators were evaluated using the determined criteria. Lerner-Frankiel et al. found that, although designated by their physical therapists as functional ambulators, only one of ten subjects was able to travel a commercial cross-walk within the given time period, and half of the subjects were unable to walk the distances needed.

Robinette and Vondran (1988) also took measurements from the six sites used in the study by Lerner-Frankiel et al. (1986). Measurements were taken from seven communities that were classified as rural towns, small towns, or cities. They found that velocities needed for safe crossing ranged from 30 to 82.5 m/min (98 to 270.7 ft./min) depending on the community. In the rehabilitation forms they surveyed, the fastest velocity patients were required to ambulate was 18.2 m/min (59.7 ft/min). Distances for the six sites ranged from 13 meters to 480 meters (42.7 feet to 1574.9 feet), with the required distance being shorter in the rural and small towns for most sites. In the rehabilitation forms they surveyed, 183 meters (600 feet) on a smooth surface was the longest distance that patients were required to ambulate. The study results showed that patients must ambulate at velocities and distances much greater than the ambulation objectives that may be set at most rehabilitation setting. They suggest that, when determining ambulation distance and velocity requirements, a physical therapist should consider the community to which the patient will return.

Although the authors in the above two studies did needed research that looked at community ambulation, they did not address velocity other than street crossing. For example, they did not address if the subjects were able to keep up with others, or if they could make it to their specified destination on time.

More research is needed to define wheelchair propulsion velocity, which would assist the therapist in writing more appropriate functional goals for children in wheelchairs. Objective and inclusive documentation, with clear goals that relate to function, would be beneficial for reimbursement of physical therapy services. The lack of extensive, empirically validated physical therapy treatment regimens contributes to insurers' negative perceptions (Rasmussen, 1992).

Health insurers have a responsibility to be prudent purchasers of health care for their members (Gleeson, 1992). Provisions of Blue Cross and Blue Shield require services to be medically necessary, that is, appropriate and reasonable for the patients disease and injury (Gleeson, 1992). Arbitrary across the board reimbursement limits have been set on physical therapy, which often results in disproportionate harm to patients with severe conditions (Rasmussen, 1992). This necessitates an increase in empirical data to demonstrate the value of physical therapy (Rasmussen, 1992). The authors feel that wheelchair propulsion velocity is an objective measure that can be used to show progress toward becoming an independent community ambulator. Studies are needed on optimal or normal baseline speed for wheelchair propulsion to provide therapists with a more objective means of evaluating children in wheelchairs.

The Functional Performance Assessment in Physical Therapy in Public Schools: A Related Service places children into functional levels according to their abilities. In this assessment, a child may be placed into a lower functional class if, for example, the child could independently propel his/her wheelchair, but has extremely slow gross motor performance (Blossom & Ford, 1991). Slow performance of a task is noted by placing an "*" next to the record of the task, and is decided by the therapist or teacher based on their experience and observed outcomes. Blossom also recognizes the importance of time by describing the calculation of the child's mean propelling speed. This is done by dividing the distance traveled by the amount of time it took to complete the task. However, this method is not used to measure outcomes or improvement in the Functional Performance Assessment.

One reference a physical therapist can turn to when determining "reasonable time" for ambulating is the normal walking speed of humans. This may also be helpful when determining functional velocities for wheelchair users. A person in a natural walk tends to adopt a speed that is close to the optimal speed for energy conservation, which is 80 m/min (262 ft/min), (Ralston, 1958). In a study of 32 normal human subjects during floor-walking, natural average speed was found to be 83.4 m/min (273.6 ft/min), which differs from the optimal speed by only 4% (Ralston, 1958). An optimal speed must be based on a choice of step rate and step length such that minimal energy expenditure per unit distance is achieved. This is and example of a fundamental feature of human motor behavior, which applies to many activities in addition to walking (Inman, Ralston, & Todd, 1981).

Findley and Agre (1988) studied the energy cost of walking and wheelchair propulsion in adolescents with spina bifida to normal adolescents. Children, aged 10-15 years, walked a distance of 30 meters (98 feet) at the subject's self-selected speed and at the maximum speed. Those children with no motor deficit walked at a speed of 80 +/- 12 m/min (262 +/- 39 ft/min) for usual walking speed and 267 +/- 40 m/min (876 +/- 131 ft/min) at maximum walking speed. The authors did not give a speed for wheelchair propulsion in normal children, only for those with spinal bifida from impairment levels L2 and above to L5 and the sacrum. Those speeds ranged from 58 +/- 10 to 72 +/-8 m/min (190 +/- 33 to 236 +/- 26 ft/min).

Another study by Williams et al (1983), with children ages 5-12 who have myelodysplasia, compared the energy cost of walking and wheelchair propulsion to normal children. A walking test at the child's chosen velocity was performed followed by a walking test at a faster velocity of their own choice. Results showed that the free velocity of regular wheelchair users with myelodysplasia, 69.9 +/- 8.6 m/min (229.3 +/- 28.2 ft/min), did not differ from the free velocity walking, 69.6 +/- 8.6 m/min (228.4 +/- 28.2 ft/min), of normal children.

Given different environments, activities, and individuals with whom persons with physical handicaps interact, there may be specific types of mobility that are conditionally more convenient, socially acceptable, or efficient than others (York, 1989). One study (Williams et al, 1983) concluded that for regular wheelchair users, wheelchairs provided faster and more energy-efficient locomotion than did walking. Lower oxygen consumption with wheelchair use could allow long-distance locomotion at a normal velocity (Findley & Agre, 1988). The Williams study also concluded that children who are regular wheelchair users would be able to move as fast as normal children who are walking.

Environmental variables have a profound effect upon eventual functional performance and must be considered potentially influential on functional outcomes (Haley, Coster, & Ludlow, 1991). Factors to consider include: type, fit, and condition of the chair (Blossom & Ford, 1991) as well as cost of a new chair; and surface, obstacles, architectural barriers, and transportation methods in the home, school and community settings. Personal factors need also to be considered, such as diagnosis and prognosis (Mattingly, 1993), physical development and mobility functioning, social and emotional growth, individual and family preferences (York, 1989), and motivation. Including velocity, endurance and environmental variables in the evaluation of wheelchair propulsion would allow for more inclusive documentation for reimbursement.

Defining objective criteria for community wheelchair ambulation of children needs to be addressed because of the growing population. The Baby Doe regulations of 1983 are federal laws that require that treatment be given to all infants. Although in 1984 congress allowed treatment to be with-held in cases of prolonged dying or futile efforts, the laws have led to an increased survival rate with unpredictable long term prognosis (Mellien, 1992). Advanced technology has also led to an improved survival rate of infants demonstrating increasingly low birth weights and gestational ages (Mellien, 1992). Although helped to live, many of the children have limited quality of life, both now and in the future (Mellien, 1992). Many of these children may become wheelchair users later in life, and may be required to function in school and the community.

It is becoming a growing trend to include students with disabilities into regular education classes (Friend, Reising, & Cook, 1993; Grosse, 1993). By federal law, PL 94-142, it is mandated that equal educational opportunities be provided for children of school age in the least restrictive environment. Least restrictive environment means that children with disabilities must be educated with those who are not disabled as much as possible. This law has a zero reject, which means that all children with disabilities must be provided a free and appropriate public education. In 1986, PL99-457 expanded the old law to include three to five year olds. Children of all abilities and diagnoses are being educated in the same environment as those without handicaps. This increases the demand being put on the child to function independently among peers without disabilities, and in an environment with less physical assistance provided.

Rehabilitation settings need to prepare the child for success with school and community wheelchair skills to optimize the child's motivation and self-confidence. Tom Richey, assistant sports coordinator for the Virginia Wadsworth Wirtz Sports Program at the Rehabilitation Institute of Chicago, states that "Whether it's going to school, attending a summer camp, or participation in sports, self-confidence and social poise receive a boost when good skills in the chair enable children to live lives of functional independence." It is the belief of many motivational theorists that feelings of competence help to motivate the individual and increase persistence (Wade, 1994).

White (1959) described the possible nature of the motivational aspect of competence. He proposed a motivational construct which he labelled "effectance" that he viewed as propelling the organism toward competence, and that was satisfied by a feeling of efficacy. He stated that there is an inherent need to deal effectively with the environment, and when this need is gratified, inherent pleasure is produced (White, 1959).

Harter expanded White's effectance motivation theory (Harter, 1978, 1982). Harter took White's generalized model and converted it into a multidimensional model by breaking it up into physical, social, and cognitive domains. Initial empirical efforts indicated that these components could be identified and operationally defined (Harter, 1978). Harter took a developmental perspective with regard to possible differences in the behavioral manifestations of effectance motivation. For example, mastery motivation, defined as the desire to successfully produce an effect on one's environment, can be observed at different developmental levels, but the manifestation of this motive varies as a function of age.

Rudisill, Mahar, & Meaney (1993) report Harter's prediction that there are four psychological constructs that contribute to the development of perceived competence. These include: past experiences, difficulty or challenge associated with the outcome, reinforcement and personal interactions with significant others, and intrinsic motivation. Past experiences include successes and failures before, during, and after rehabilitation. The balance between successes and failures affects the development of a child's competence in wheelchair skills. A child's perception of competence in the community will be affected by their ability to keep up with peers and get to destinations on time.

Validation of velocity requirements will help the therapist set goals that will appropriately prepare the child for function in the community.

Harter also expanded White's formulation that success generally leads to feelings of efficacy or intrinsic pleasure. She obtained a clear-cut linear relationship between pleasure, as reflected in smiling, and level of difficulty for those tasks that were successfully solved (Harter, 1978). In a follow-up study that included items with higher levels of difficulty, a decrease in pleasure was demonstrated for successful items that were judged as very hard (Harter, 1978). Subjects were extremely sensitive to the time dimension and verbally expressed dissatisfaction over their performance if they felt the solution time was too lengthy.

Harter's (1981a) competence motivation theory has provided a useful theoretical guide and has garnered substantial support in the study of children in sport (Weiss, 1987). Weiss et al. (1986) used causal modeling procedures to investigate the influence of perceptions of competence and control in the sport domain on motivational orientation and achievement of 8- to 12-year-old children attending a summer sport program. Results supported Harter's theory in that perceptions of one's physical competence positively influenced levels of sport competence and intrinsic motivation.

Self-perceptions in the sport domain appear to be powerful predictors of a child's persistence and degree of success in sports (Weiss & Horn, 1990). Although most motivational studies have been done on sport, results may be related to rehabilitation because both require physical training for achievement of goals. Ulrich (1987) states that the motive to participate or continue participation may be mediated by an individual's perception of competence toward a task or activity. Therefore, rehabilitation settings need to prepare the child for success in community wheelchair skills to optimize the child's motivation and self confidence.

Realizing the importance of accurate self-perceptions of competence with regard to motivation, Harter (1982) developed a perceived competence scale for children based on her model of competence motivation (Harter, 1978). The scale consists of three sections, each designed to measure one of the three domains from her theory: cognitive, social, and physical. She designed the physical domain scale with a focus on sports and outdoor games. The validity and reliability of this scale have been demonstrated (Harter, 1982). Ulrich (1987) proposed that consideration be given to choosing motor items that relate to those motor activities in which the sample subjects are frequently engaged. Using Ulrich's suggestions, the study conducted by Rudisill et al. (1993) developed the Motor Perceived Competence Scale (MPCS) questionnaire that was based on physical education rather than sports, since not all children are involved in sports. The MPCS is similar in form to a semantic differential scale. Items are designed so the subject circles the number between the two opposite statements which best represents personal feelings about the statement. Both internal consistency reliability and stability reliability were .88. The scale's validity was documented with factor analysis, teachers' ratings, and motor performance. An alpha factor analysis followed with Cattell's (1966) scree test supported the unidimensionality of the scale.

Rudisill et al. (1993) examined the relationship between children's perceived and actual motor competence. The Motor Skill Perceived Competence Scale was completed by 218 children aged 9-11 years. The children then completed a series of gross motor tests that measure the subject's actual motor competence with components that paralleled the items on the scale (Baumgartner & Jackson, 1991). The motor tests consisted of the standing long jump, the 50-yard dash, the shuttle run, and two ball throws. The AAHPERD Youth Fitness Test Guidelines were followed. Upper body and lower body factors were identified as two actual motor competence dimensions. Multiple correlation between perceived and actual motor competence for the two factors indicated that children were moderately accurate in assessing their competence. The older children were not more accurate in assessing their competence than were the younger children.

Another study by Rudisill et al. (1993) concluded that children ages 9 to 11 may possess the cognitive abilities necessary to observe and acknowledge personal and situational experiences, but it is not until approximately age 12 that they are capable of synthesizing all the information into an accurate conclusion regarding their competence.

Horn and Weiss conducted a study in 1989 that looked at the developmental analysis of children's self-ability judgments in the physical domain. Age-related changes in the relation between perceived physical competence and a teacher's ratings of the child's ability were examined. The study found that children became more accurate in their perceived competence with age, and children aged 8-9 years were significantly less accurate than children 10-13 years of age. Another study conducted by Horn and Weiss (1991) found that children's evaluation of their physical performance was age dependent.

> Children under the age of ten placed more importance on evaluative feedback from their parents and on their attraction to sport where as children between the ages of 10 and 13 showed greater orientation toward peer comparison and evaluation as a means for evaluating own competence. These findings, then, suggest that increase accuracy in competence judgements may be related to changes in the criteria used to form such judgements (Horn, & Weiss, 1991).

According to Piaget (1955), it is not until approximately ages 11 or 12 that children advance into the formal operational intelligence stage. In this stage, children are capable of problem solving and performing logical and abstract thinking. Based on the previous studies the authors have chosen the age of 11 years for this study.

The need to match a reader's ability to the text difficulty lead to the development of readability formulas. Readability formulas are objective, quantitative tools for estimating the difficulty of written material without testing readers (Rush, 1985). Formulas can assess texts that have a wide range of content and prose styles (Rush, 1985). Microcomputer technology has made readability formulas more convenient.

The text of the questionnaire was analyzed with Professional Write, version 2.2 computer program (Software Publishing Corporation, 1990). The readability scores for the questionnaire are as follows: Flesh Reading Ease (94), Gunning's Fog Index (grade level 5), and Flesh-Kincaid Grade Level (2).

The Flesch Reading Ease score is based on the average sentence length and the number of syllables per 100 words. This is done by first multiplying the average sentence length by 1.015 and multiplying the number of syllables per 100 words by .846. Next, the two figures are added and the total is subtracted from 206.835.

Gunning's Fog Index measures the approximate grade level a reader should have achieved to comprehend your document. The average number of words per sentence is added to the number of words with three of more syllables. This figure is then multiplied by .4. The product is the approximate reading grade level.

The Flesch-Kincaid Grade level is calculated by first multiplying the average number of words per sentence by .39, and multiplying the average number of syllables per word by 11.8. These two figures are added together and 15.59 is subtracted from the total. This gives the approximate grade level.

The correlation coefficient for recent readability formulas is around .70. This means that roughly one-half of the variance in readability of criterion passages is accounted for by Flesh's formula (Klare, 1963). The recalculated Gunning formula yielded coefficients of .59 (Klare, 1963).

It is necessary to assess a subjects reading achievements to be sure that the subject can read the questionnaire. The Wide Range Achievement Test - Revised (WRAT-R) level 2 will be used to determine the subjects readability grade level. The WRAT-R has been in use since 1936 and has been revised many times over the years. "The WRAT-R has been researched extensively on many thousands of persons from preschool through adulthood."(Jastak, & Wilkinson 1984) In the text A Compendium of Neuropsychological Tests: Administration, Norms, and Commentary, Spreen and Strauss state that the WRAT-R may be useful as a quick, but gross, screening device. (Spreen, & Strauss, 1991) A study done by Dura et al. found the WRAT-R was a stable measure within an adolescent psychiatric inpatient population regardless of diagnostic category. (Dura, Freathy, & Myers, 1989)

The construct validity of the WRAT-R is strongly supported by the item separation reliability coefficients. Jastak and Wilkinson's data indicate that in each subtest there is a well defined variable line with sufficient coverage of item difficulty. There are numerous studies which correlate the results of the WRAT-R with other achievement and ability tests. The results are favorable with correlations in the high .60's, .70's, and .80's.

Our questionnaire was developed based on the Rudisill, et al. (1993) Motor Perceived Competence Scale. The questions were modified to apply to children in wheelchairs, and written with elements of the FIM scale in mind. The FIM scale determines functional independence according to the amount of assistance needed and the distance traveled in a timely fashion. Topics covered by the perception questionnaire include normal propelling velocity, fast propelling velocity, distance, endurance, and the amount of assistance needed. Although the FIM does not address velocity, it was included in our questionnaire because of its importance to our study.

Continued efforts are needed to develop and improve upon models that will enable researchers to better define functional outcomes. A recent priority in research is the development of functional outcome measures that can be used to identify change and improvement in function. "The development and use of outcome measures are the pivotal links that allow practitioners to examine the purposes, effectiveness, and justifications for rehabilitation" (Haley, Coster, & Ludlow, 1991). Further definition of evaluation tool criteria will help establish functional velocity goals. This is important not only for reimbursement purposes, but also because it meets the needs of a growing number of community wheelchair ambulators and may have a positive effect on their feelings of competence.

CHAPTER 3: METHODOLOGY

In this study, male and female subjects aged 11-17 completed three 150 foot timed trials with a manual wheelchair on a smooth, level surface. The population should include at least 40 or more subjects to be statistically significant. Subjects were selected with the help of Dr. Hotchkiss' database at Mary Free Bed Hospital and Rehabilitation Center and through local professionals. The subjects must be dependent on the wheelchair for community ambulation and must be able to propel a distance of at least 150 feet x 3. Each subject used the wheelchair they use most often in social/community outings. The subjects must also be able to read and answer a few, simple questions.

Parental consent was obtained before the subject takes part in the study. The parent/guardian will receive a short description of the study, an information form with questions regarding the child, and the informed consent form. Permission to use school hallways will also be obtained via telephone prior to the testing day.

In the school hallway a straight distance of 150 feet (as stated by the FIM scale as independent using a wheelchair) was measured with a 100 foot tape measure and marked with masking tape at the start and finish. A width of five feet will be measured and marked intermittently the entire length. The subject was instructed to propel his or her wheelchair at their best speed from start to finish on the smooth, level surface while being timed on a digital stopwatch. At least two testers will be present during the timed trials, one tester positioned at each end. The tester at the start lowered one arm to signal the timer at the finish. As the arm lowered to hit the leg, the starter gave the subject this command "You may start". Each subject propelled this distance three times with one minute between each trial. If they were unable to complete this distance, they were instructed to say, "Stop." Each child was be closely observed during the trials, and if they appeared to be having medical difficulties the trials were stopped immediately.

Following these time trials, each subject filled out a questionnaire regarding the perceptions of their ability in the community. Each question had a scale of numbers from one to five. The questions were randomly selected to have the number one as the lowest rating of function or the number five as the lowest rating of function. Each subject was instructed to circle the number closest to how he/she felt. The tester specifically instructed each subject, "Notice in the first question the number one means cannot, but in the third question the number one means can."

The subject was given a reading screen prior to the timed trials to insure they were able to read at a fourth grade level. The WRAT-R Level 2 Reading subtest consists of a pre-reading level and a formal reading level. The children were screened at the formal reading level as follows. The tester pointed to the first word and said: "Look at each word carefully and say it aloud. Begin here (point) and read the words across the page so I can hear you. When you finish the first line, go on to the next line, and then the next, etc." The first time an error occured, the subject was asked to say the word again, and the response was scored right if the subject corrects himself/herself. The subject was scored either right or wrong on the first response unless he/she spontaneously corrects the error. The subject had 10 seconds per word with a test limit of 10 consecutive errors. One point was awarded per word making a possible score of 74 points with a total raw score of 89 points (15 pre-reading + 74 formal reading points).

Each subject was given a number under which the data was recorded. At no time was the subject's name be used in the collection or results and discussion of the data. It took about 15 minutes to complete the reading screen, time trials, and the questionnaire for each subject.

This project was presented to the Human Subjects Review board at Grand Valley State University. Upon passing GVSU's review board, the study was given to the human subject review boards at Mary Free Bed Hospital (See appendix A).

After the data was collected, the Pierson Product Correlation Coefficient alpha was used to correlate the child's perception of function with their average time of the three trials. A reliability analysis (SPSS) of internal consistency between questionnaire items and between time trials for each subject was also performed. Subjects were then grouped and evaluated for trends according to varibles which may affect velocity and perceived function.

CHAPTER 4: RESULTS AND ANALYSIS

Subjects recruited for this study were located with the help of Mary Free Bed Hospital and Rehabilitation Center, the pediatric data base developed by Dr. Hotchkiss, and local professionals. Subjects participating in this study consisted of ten males and one female who propelled their wheelchairs with both upper extremities. The subjects ages ranged from 11 to 17 years with a mean age of 14 years. Five diagnoses were represented with the majority of children having spina bifida. The demographic variables are shown in Table 1. A frequency distribution was used to determine the frequency and averages of the demographic variables (Appendix C).

Table 1

Demographic Variables:

Table 1a

Diagnosis	Frequency
Spina Bifida	5
Quadriplegia	1
Paraplegia	3
Cerebral Palsy	1
Rheumatoid Arthritis	1

Table 1, continued.

Table 1b

Age	Frequency
11	3
12	1
14	1
15	1
16	2
17	3

The subjects' times varied from as fast as 11 seconds to as slow as 34 seconds, with an average wheelchair speed of 17.5 seconds over a 150 foot distance. The average wheelchair time for each subject as well as their rated perceived function is in Table 2. Perceived function is rated on a scale of one to five with five being the highest or most positive score.

Table 2

Subject wheelchair velocities and overall perceived function

Subject	Average wheelchair time (seconds)	Overall perceived function
1	11	4.78
2	16	4.28
3	20	4.22
4	14	4.23
5	17	4.83
6	12	4.17
7	15	5.00
8	18	4.33
9	16	4.61
10	19	4.78
11	34	4.50

Note. Overall perceived function is the average of the subject's answers to each item on the questionnaire. Maximal overall function is 5.

Reliability analysis was used to determine inter-item correlations of the wheelchair time trials for each subject as well as of the questionnaire. The wheelchair times for the subjects were shown to be highly reliable with coefficient Alpha = .9961. This means that the subjects consistently propelled nearly the same speed for all three time trials. Questionnaire items were shown to be moderately reliable with coefficient Alpha = .6848, which demonstrates that each subject answered the items in the questionnaire with a similar degree of perceived function. A frequency distribution of the individual questionnaire items showed that all subjects rated their function on the high end of the five point scale. The number representing the highest level of function was selected most frequently, and was circled by 100% of the subjects on two of the questions. The number representing the lowest possible function was only selected once by one subject (see Appendix C).

The two-tailed significance test of the correlation between wheelchair times and overall perceived function proved to be insignificant with $r(9) = -.0357$, $p = .917$. One subject's wheelchair time trials were somewhat slower than the other ten. Deleting this subject from the analysis made little difference, $r(8) = -.0217$, $p = .953$. The same significance test was used to evaluate the correlation between wheelchair times and the perceived function rating of each individual question. Only one item showed a significant correlation, $r(9) = -.8126$, $p = .002$. Raw data is contained in appendix C.

The data was organized according to age and compared with the individuals average wheelchair velocity, and average overall perceived function (see Table 3). When compared with average wheelchair velocity the three 11 year old subjects averaged 18 seconds, 5 seconds slower than the three 17 year old subjects. Two of the eleven year old subjects had upper extremity involvement, as well as the only 12 year old subject. The 12 year old subject had the slowest time of 34 seconds. The overall perceived function was averaged within the age groups using the individual's overall perceived function average. The average overall perceived function rating showed no trend when compared with age.

Table 3

Age group comparisons of average wheelchair velocity and perceived function

Age	Average Velocity (sec)	Perceived Function
11	18	4.41
12	34	4.50
14	17	4.83
15	16	4.28
16	17	4.67
17	13	4.52

When the data is grouped by diagnosis, a difference in average wheelchair velocity is noted in subjects with upper extremity involvement. The subjects were first grouped into one of three diagnoses: spina bifida, paraplegia and other which included quadriplegia, cerebral palsy and rheumatoid arthritis. Accordingly, each subject's average wheelchair velocity was used to determine the groups' average velocity. All subjects propelled their wheelchairs with both upper extremities only. The subjects with spina bifida had the fastest average wheelchair velocity which was three seconds faster than those diagnosed with paraplegia. However, these two groups had no upper extremity involvement. The group with upper extremity involvement had the slowest time; ten seconds slower than those with spina bifida and seven seconds slower than those with paraplegia (see Table 4).

Table 4

Average Velocity Grouped by Diagnosis

Diagnosis	Spina Bifida	Paraplegia	Other
Average velocity (sec)	14	17	24

Note. The diagnosis other refers to quadriplegia, rheumatoid arthritis, and cerebral palsy. These diagnoses were grouped together because of upper extremity involvement.

Based on the length of time a subject has been dependent on a wheelchair, the subjects were grouped into four categories: less than one year, one to five years, five to ten years and longer than ten years. This was compared to the average wheelchair velocity for each group. The group average velocity was determined by taking each subject's average wheelchair velocity. In the category of less than one year only one subject with the diagnosis of paraplegia is represented. The second category was represented by two subjects, both with upper extremity involvement, and the third subject with upper extremity involvement fell into the five to ten year category. The third and fourth groups were represented by three subjects and five subjects, respectively (see Table 5).

Table 5

Average velocity and length of time dependent on wheelchair

Time (years)	<1	1-5	5-10	>10
Average velocity (sec)	18[a]	27[b]	17	14

[a]Only one subject is represented by this time.
[b]This time is represented by only two subjects, both of which had upper extremity involvement.

A comparison was also performed between the age of the chair and the average wheelchair velocity. The age of the chair in years was divided into two categories: those four years and newer and those greater than four years old. Six subjects made up the group with newer wheelchairs, and five subjects made up the second group. This comparison showed that the group of subjects with a newer wheelchair propelled an average of four seconds faster than those with older wheelchairs (see Table 6).

Table 6

Average velocity and the age of the subjects wheelchair

Age of chair (years)	0-4	>4
Average velocity (sec)	16	20

The authors hypothesized that there would be a significant relationship between a child's perceived function in the community and their wheelchair velocity over a given distance. This statistical analysis indicates the null hypothesis can not be rejected. Further comparisons of the data yielded more information to be discussed in the following chapter.

CHAPTER 5: DISCUSSION AND IMPLICATIONS

This pilot study of 11 subjects did not support the authors' hypothesis that there would be a significant relationship between a child's perception of function and their wheelchair velocity. Yet, because of the small sample size used, no conclusions can be made concerning the authors' hypothesis. Despite the lack of statistical evidence, the study did yeild some descriptive details of interest.

All subjects tended to rank high in overall perceived function. A study by Horn and Weiss in 1991 found that children aged 10-13 years showed greater orientation toward peer comparison and evaluation as a means for evaluating their own competence. As peers, the subjects saw themselves functioning at a similar level, and this is reflected in their overall perceived function. The overall perceived function ranged from 4.17 to 5.00. When the subjects were grouped by age little difference between age groups was found (see Appendix C). Also, because many of the subjects were involved in wheelchair sports, they may have had a higher level of perceived competence. These results supported Harter's theory (1981a) in which one's perceptions of physical competence may positively influence levels of sport competence and intrinsic motivation.

All children rated themselves at the highest level of function at both the school and the store/mall settings for the following question: "I can wheel my chair with help/without help." Only one question was ranked at the lowest level of function by only one subject in the school setting, but for the same question this subject perceived the highest level of function in the store/mall setting. That question was as follows: "I can/cannot keep up with others." This could be due to subject error in filling out the questionnaire. The number signifying the highest level of function was purposely reversed on the questionnaire which may have led to an error (for questionnaire, see Appendix B) .

Certain trends were found when individuals were divided into like groups. Although all subjects propelled with both upper extremities, three subjects had upper extremity involvement. When individuals were divided by diagnosis, it was found that those with upper extremity involvement were slower than those without upper extremity involvement. This shows that an individual's ability to propel their chair at a functional community velocity may be compromised if there is upper extremity involvement.

The data was also analyzed for trends in wheelchair velocity and self perception as related to age. When age was compared to wheelchair velocity, the youngest participants propelled at a slower speed than the older subjects. All three subjects with upper extremity involvement were included in the younger age group, which may have contributed to the difference in propelling speed. However, this comparison may also provide evidence that older subjects may propel at faster velocities than younger subjects. Self perceptions did not demonstrate a relationship with age.

Another trend found with the subjects in this study is that propulsion speed was affected by the length of time the subject required use of a wheelchair (see Appendix C). This shows that experience could also have an effect on a person's ability to propel their manual wheelchair at a functional velocity in the community. Therefore, it may not be appropriate to compare the wheelchair velocity of someone with a new injury in a rehabilitation setting to someone who has had much experience propelling their wheelchair in the community.

Lastly, a trend was found between the age of the wheelchair and the subject's wheelchair time. The children who used wheelchairs which were four years old or less propelled an average of four seconds faster than those who's wheelchair was greater than four years old. As stated by Gleeson, health insurers are increasingly becoming more prudent purchasers of health care (1992). This involves the purchase of new equipment, including wheelchairs. Showing that old chairs will significantly decrease a patient's speed could assist with increasing reimbursement for a new wheelchair in the future.

No comparison could be made between wheelchair velocity and the style of wheelchairs used by the individual subjects in this study. The only data collected concerning the individual wheelchairs was the actual make of the wheelchair and it's age. Of the 11 subjects participating in this study eight different styles of wheelchairs were used. Of these eight styles, each wheelchair had been individualized to the owner's needs.

Findley and Agre (1988) did a study on walking speed with normal children aged 10-15 years. They found that maximum walking speed was 267 +/- 40 m/min. (876 +/- 131 ft/min.). All 11 subjects in this study propelled a distance of 150 feet in a an average time of 17.5 seconds, with an average velocity of 514 ft/min. The wheelchair velocities ranged from 265 ft/min. to 818 ft/min. The subjects who propelled at faster velocities compared favorably with the maximum walking speed of the normal children in Findley and Agre's (1988) study. This suggests that the subjects involved in the study should have been able to keep up with walking peers, which was one question included in the questionnaire.

Although the authors feel this is a valuable study that emphasizes the importance of including wheelchair velocity criteria in evaluation tools, it presents with numerous limitations. The primary demographic constraint is the low number of subjects available for participation. Many prospective participants were excluded from the study due to their inability to read at a fourth grade level or propel a distance of at least 150 feet. A questionnaire prepared at a lower grade level, or choosing to read the questionnaire to the subjects, could have increased the number of participants. The number` of participants was also limited to the time constraints for collecting data, limiting the research to local areas. Also, females were under represented, with only one female participant in the study, and all diagnoses were not equally represented. Using an equal number of females and males would have allowed a comparison to be made between gender and wheelchair times, and between gender and perceived function. A third demographic constraint is that the majority of the subjects were participants in local wheelchair sports. A greater diversity of skill levels would have made for a more comprehensive study.

The questionnaire used may not have been sensitive enough to evaluate the child's self perpections accurately. The questionnaire did not contain items regarding higher levels of functions. For example, such items may include questions that ask the child about his/her participation in sports, obstacles in the environment, and unlevel surfaces.

With the use of a more sensitive questionnaire, a greater diversity of perceived function may have been found.

The authors found that both the mall and local schools had various propelling surfaces, rather than just tile. Therefore, the questionnaire, which included both the school and mall, asked questions regarding two surface types. Thus the first part of the questionnaire is about propelling on carpeted halls at school, and the second part is asking about function on a tiled surface. The 150 foot distance required for the study limited the research to carpet due to this surface type being the most common in the hallways of many schools. Because velocities vary with different surface types, the testing surface should correlate with the surface type of the community settings in which the subject functions.

A final limitation is in the time measurements due to the start/stop time not being adjusted for in the subjects' time trials. Start time refers to the time it takes for the individual to begin propelling their chair and to accelerate to their best speed, which may vary between subjects. Stop time is a limitation because some of the subjects decelerated when approaching the end tape. This could have been avoided by having a measured length prior to the start line and after the stop line.

This study begins the process of establishing baseline data for wheelchair velocity studies. This data is needed to improve upon goal setting, and further define "reasonable time" in evaluation tools such as the FIM . Expansion of this baseline data can be helpful with assuring reimbursement from insurers by defining functional wheelchair velocity criteria, addressing the needs of a growing number of community wheelchair users.

More children in wheelchairs are functioning in the schools due to the growing trend of mainstreaming. With properly set goals, the child may be able to achieve a greater degree of success in function. This, in turn, may provide for positive experiences and enhance their self-perceptions.

There are many valuable ways in which this study could be expanded in the future. First of all, wheelchair velocity norms can be developed for various ages, diagnoses and wheelchair styles for free and fast speeds. Future normative studies should also be expanded to include other community and outdoor settings. This normative data could be used in rehabilitation facilities for setting appropriate and functional wheelchair velocity goals. Insurers may be willing to reimburse for longer periods of physical therapy services if the advantages of faster wheelchair velocities for easier reintegration into the community is demonstrated. It could also provide justification for purchase of a lighter, more expensive style wheelchair.

Second, there are many factors that have an effect on wheelchair velocity. Testing should be done on various surfaces including tile, carpet of all thicknesses, asphalt, and other uneven surfaces. Subjects with different modes of propulsion, other than both upper extremities, should also be tested to determine the effect on velocity. Curbs, grades and other obstacles offer more challenges to wheelchair users. Environmental variables have a profound effect upon eventual functional performance and must be considered a potentially important influence on functional outcomes (Haley, Coster & Ludlow, 1991).

Third, another source should be used to determine the subject's function in the community, such as a physical therapist or teacher. These sources may be more accurate at determining actual functional ability of the subject. This information could be correlated with the average wheelchair velocity of the subject, as well as their perceived function of the subject to assist in determining the accuracy of the subject's perceptions. To accurately assess a subjects self perceptions, a more sensitive questionnaire can be developed, or the questionnaire can be eliminated and function assessed solely by the teacher or the physical therapist.

In conclusion, this is a baseline study which begins the process of establishing wheelchair velocity data. The authors hope that others will continue to build upon this foundation of work. When more extensive data is available on wheelchair velocity, therapists will be able to access this information for the benefit of their patients.

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APPENDIX A

Human Subjects Review Application

HUMAN RESEARCH REVIEW COMMITTEE

Principal Investigator: Karen Feuerstein, Susan Fisher, Kristy Van Zee

Department of School: Physical Therapy

Address and Telephone: Susan Fisher 3936 Summit View Dr NE Grand Rapids MI 49505 (616) 361-6721

Title of the Project: Timed Wheel Chair Ambulation of Children Aged 12-17 Years and Their Perceptions of Their Function.

Summary of the Project:

Assessment of wheelchair ambulation is frequently done with each child's visit to the clinic. Our proposal is to time the already existing functional assessment. Therefore there will be no added danger to the subjects. In fact with the addidtion of three observers the safety of the child will be increased. The benefits, as well as the methodology is contained in the attached proposal.

In what capacity does this project involve human subject? (E.g., surveys, interviews, clinical trial, use of medical records, etc.)

Clinical trials, and medical records

Check one:

___ This is a report on research on human subjects which is exempted by 46.101 of the Federal Register 4616:8336, January 26, 1981. (Refer to instructions on the reverse of this form.)

___ This is a request for expedited review as described in 46.110 of the Federal Register 46(16):8336, January 26, 1981. (Refer to instructions on the reverse of this form.)

✓ This is a request for full review. (Refer to instructions on the reverse of this form.)

____________________ Principal Investigator

[redacted] Department Chair or Advisor

__________ Date

9-14-94. Date

Rev. 8/88

APPENDIX B

Methodological forms

INTRODUCTORY LETTER TO PARENTS

Dear parent or guardian,

We would like to thank you for allowing us to send you this information regarding our study. Following is a description of the project and its importance to children who are dependent on wheelchairs.

Your child will be asked to propel his or her own wheelchair a distance of 150 feet on a flat, tiled surface at their best speed while being timed. He or she will complete this three times. This will prevent him or her from trying to race against the clock. After the time trials, a short questionnaire will be administered. An example of the type of statement used would be:

I _______ like to watch TV.   do not 1 2 3 4 5 do

The child will be asked to circle the number which corresponds with their feelings about the statement to the best of their ability.

It will take approximately 15 minutes to complete the time trials and the questionnaire.

As physical therapy students, we have all been exposed to different rehabilitation settings. A common test used to determine function is the Functional Independence Measure or FIM scale. Many different items are included, one of which is wheelchair propulsion. The criteria for being independent with a wheelchair is for the person to propel his or her wheelchair a distance of 150 feet. However, no time is correlated with this distance. We feel this project would develop a baseline speed for wheelchair mobility by correlating the average time from the three trials with the child's perception of function. This would be of great help for setting more effective goals in rehab facilities; goals for discharge plans and for the transition from rehab to the community.

We would appreciate your participation in this study. If you have any questions or concerns, please feel free to contact us. Thanks again!

Sincerely,

Karen Feuerstein
(616) 878-9235

Susan Fisher
(616) 361-6721

Kristy Van Zee
(616) 891-9814

INFORMED CONSENT FORM

Project: Timed Wheel Chair Ambulation of Children Aged 12-17 Years
and Their Perceptions of Their Function
Approved by Mary Free Bed Hospital's Human Subject Review Committee

This testing should take approximately 15 minutes per subject. Each subject will complete three time trials on a flat, tiled surface over a distance of 150 feet. Subjective data regarding the condition of the wheelchair will be collected by one of the testers. A questionnaire will then be administered to the subject in which a few simple questions will be asked about their performance in the community and with peers.

I,_____________________, agree / do not agree to let my child, _______________, participate in this research project under the direction of Karen Feuerstein, Susan Fisher, and Kristy Van Zee Physical Therapy students at Grand Valley State University.

I understand that:

1. The information I provide and the results of each individual will be kept strictly confidential.
2. My child may not participate if he or she have any health problems that would contraindicate participation.
3. My child's participation in this study is voluntary and we may withdraw at any time without any prejudice from the research team or the clinic.
4. Participation / nonparticipation in this study will not effect any other clinic activities.

Participant Statement

This study has been fully explained to me and I have had the opportunity to ask questions. I voluntarily consent to let my child participate in this study.

Signature:________________________ Date:______________

Please indicate if you would like to receive a copy of our test results by circling yes or no.

YES **NO**

INFORMATION FORM

Name of subject:

Age of subject:

Name of school presently attended by the subject:

How long has your child been using a manual wheelchair (years:months)?
Is your child dependent on the wheelchair in the community and able to propel for a distance of at least 150 feet?

Does your child have any health problems that would contraindicate his or her participation in this study ?

About his/her wheelchair:

Model/name:

Year:

Date of purchase:

DATA COLLECTION FORM

Subject Number:

Age:

Condition of the wheelchair: (tires, proportion to subject, etc.)

Dx:

Commands to each subject:

You may begin.

Method of propulsion: (circle one)

one UE

both UE's

one UE and one LE

one LE

both LE's

other

Reading Score:

Propelling surface: TILE

Distance propelled
Time (min:sec)

1.
2.
3.

QUESTIONNAIRE

READ CAREFULLY!

At school:

I ______ keep up with others.	can not 1 2 3 4 5 can
My speed is ____.	fast 1 2 3 4 5 slow
I ____ go fast when I am in a hurry.	can 1 2 3 4 5 can not
I have ____________ .	a lot of energy 1 2 3 4 5 very little energy
I can wheel my chair _________ .	with help 1 2 3 4 5 without help
I ______ get where I need to be on time.	can 1 2 3 4 5 can not
I ask for help _______ .	often 1 2 3 4 5 not very often
I can wheel my chair a ___________.	short distance 1 2 3 4 5 long distance
When others help me, they do ________ of the work.	a lot 1 2 3 4 5 a little

At the store / mall:

I ______keep up with others.	can 1 2 3 4 5 can not
My speed is ____.	slow 1 2 3 4 5 fast
I ______go fast when I am in a hurry.	can not 1 2 3 4 5 can
I have ________ .	very little energy 1 2 3 4 5 a lot of energy
I can wheel my chair ________ .	without help 1 2 3 4 5 with help
I ______ get where I need to be on time.	can 1 2 3 4 5 can not
I ask for help __________ .	not very often 1 2 3 4 5 often
I can wheel my chair a __________.	long distance 1 2 3 4 5 short distance
When others help me, they do _______ of the work.	a lot 1 2 3 4 5 a little

INSTRUCTIONS

I _______ like to watch TV. do 1 2 3 4 5 do not

I _______ like to read books. do not 1 2 3 4 5 do

"I would like you to circle the number that is closest to how you feel. Take your time and be sure you read each one carefully. Notice that on the first statement 'do' is on the left, but on the second statement 'do not' is on the left. If you do not understand a question, answer it the best you can. If you cannot read a word, I will help. You have as much time as you need."

(Hand child questionnaire.)

"Here is your pencil. You may start."

APPENDIX C

Raw Data

Table 1

Demographic Variables:

Table 1a

Diagnosis	Frequency
Spina Bifida	5
Quadriplegia	1
Paraplegia	3
Cerebral Palsy	1
Rheumatoid Arthritis	1

Table 1b

Age	Frequency
11	3
12	1
14	1
15	1
16	2
17	3

Table 2

Subject wheelchair velocities and overall perceived function

Subject	Average wheelchair time (seconds)	Overall perceived function
1	11	4.78
2	16	4.28
3	20	4.22
4	14	4.23
5	17	4.83
6	12	4.17
7	15	5.00
8	18	4.33
9	16	4.61
10	19	4.78
11	34	4.50

Note. Overall perceived function is the average of the subject's answers to each item on the questionnaire. Maximal overall function is 5.

Table 3

Age compared to wheelchair velocity

Age	Average Velocity (sec)	Perceived Function
11	18	4.41
12	34	4.50
14	17	4.83
15	16	4.28
16	17	4.67
17	13	4.52

Table 4

Average Velocity Grouped by Diagnosis

Diagnosis	Spina Bifida	Paraplegia	Other
Average velocity (sec)	14	17	24

Note. The diagnosis other refers to quadriplegia, rheumatiod arthritis, and cerebal palsy. These diagnoses were grouped together because of upper extremity involvement

Table 5

Average velocity and length of time dependent on wheelchair

Time (years)	<1	1-5	5-10	>10
Average velocity (sec)	18[a]	27[b]	17	14

[a]Only one subject is represented by this time.
[b]This time is represented by only two subjects, both of which had upper extremity involvement.

Table 6

Average velocity and the age of the subjects wheelchair

Age of chair (years)	0-4	>4
Average velocity (sec)	16	20

Table 7

Wheelchair Raw Data

Subject	Age	Diagnosis	Sex	Time 1 (secs)	Time 2 (secs)	Time 3 (secs)
1	17	Spina Bifida	M	11	11	11
2	15	Spina Bifida	M	16	16	16
3	11	Quadriplegia	M	19	20	21
4	11	Spina Bifida	M	14	14	14
5	14	Paraplegia	M	17	17	18
6	17	Spina Bifida	M	12	12	12
7	16	Paraplegia	M	15	15	15
8	16	Paraplegia	M	18	18	18
9	17	Spina Bifida	F	16	15	16
10	11	Rheumatoid Arthritis	M	18	19	21
11	12	Cerebral Palsy	M	34	35	33

Table 8

Wheelchair Time Trials Reliability Analysis

Inter-item correlation

Mean	Minimum	Maximum	Range	Max/Min	Variance
.9897	.9827	.9970	.0143	1.0146	.0000

Table 9

Questionnaire Raw Data

Key: For the pupose of this chart answers are ranked from 1 to 5 with 1 being the most negative response and 5 the most positive response.

Section A: At School

Subject	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
1	5	5	5	5	5	5	5	5	3
2	4	4	3	4	5	5	5	4	4
3	4	4	4	5	5	4	5	5	5
4	4	3	4	5	5	5	5	5	3
5	5	3	5	5	5	5	5	5	5
6	4	4	4	5	5	4	4	4	4
7	5	5	5	5	5	5	5	5	5
8	4	2	3	4	5	5	5	4	5
9	4	3	5	4	5	4	4	5	5
10	5	2	5	5	5	5	5	5	5
11	1	3	3	5	5	5	5	5	5

Table 9, Continued.

Questionnaire Raw Data

Key: For the pupose of this chart answers are ranked from 1 to 5 with 1 being the most negative response and 5 the most positive response.

Section B: At the Mall

Subject	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
1	5	5	5	5	5	5	5	5	3
2	4	4	4	4	5	5	5	3	5
3	4	4	4	5	5	2	5	5	1
4	4	4	2	5	5	5	5	5	3
5	5	4	5	5	5	5	5	5	5
6	5	4	2	5	5	4	4	4	4
7	5	5	5	5	5	5	5	5	5
8	4	4	4	5	5	5	5	4	5
9	5	5	5	5	5	4	5	5	5
10	5	4	5	5	5	5	5	5	5
11	5	5	4	5	5	5	5	5	5

Table 10

Perceived Function Reliability Analysis

Inter-item Correlations:

Mean	Mininmum	Maximum	Range	Max/Min	Variance
.1652	-.3957	.9238	1.3195	-2.3345	.0879

Table 11

Item-total Satistics

Time Trial	Corrected Item-Total Correlation	Squared Multiple Correlation
1	.9927	.9946
2	.9975	.9967
3	.9868	.9810

Alpha = .9961 **Standardized item alpha** = .9965

Table 12

Item-total Statistics

Question	Corrected Item-Correlation
R1	.2115
T2	-.0376
T3	.6324
T4	.1755
T6	.3488
R7	.1579
R8	.5278
R9	.0964
T10	.6210
R11	.4660
R12	.6782
R13	.2294
T15	.2759
T16	.3616
T17	.4343
R18	.1634

Alpha = .6848 **Standard item alpha** = .7600

Table 13

Raw Data Summary

Variable	Mean	Std Dev	Minimum	Maximum	Sum
WT	17.48	6.15	11.00	34.00	192.33
PF	4.53	.29	4.1667	5.00	49.78

Table 14

Alpha values for individual questions

Questions	Correlations
At school: 1	-.8126*
2	-.3884
3	-.4581
4	.0970
6	.1666
7	.2934
8	.2245
9	.5331
At the mall: 1	.0625
2	.1845
3	.1265
4	.0800
6	-.0042
7	.2956
8	.1913
9	.1880

Note. Questions 5 and 14 were not included in the correlation analysis because these questions were answered identically by 100% of the subjects.
$^{*}p < .01$.